Interdisciplinary management of a patient with advanced dental needs

Desmond CV Ong[*†] and Kenneth Crasta[†]
Discipline of Orthodontics, School of Dentistry, University of Queensland, Brisbane[*] and Private Practice, Townsville,[†] Australia

The present case report outlines the interdisciplinary management of an adult patient presenting with advanced generalised periodontal attachment loss, an upper dental midline discrepancy following the previous extraction of the upper left central incisor, and significant lower arch crowding. The endodontic and periodontal condition was stabilised prior to the commencement of fixed appliance orthodontic treatment and subsequent prosthetic replacement of the upper left central incisor. Interdisciplinary management provided a functional occlusion and stability of the periodontal condition along with pleasing facial and smile aesthetics.
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Desmond Ong: desmondc_ong@outlook.com; Kenneth Crasta: kencrasta@gmail.com

Introduction

Periodontally-affected patients may present and be affected by any combination of the following orthodontic issues: proclination of the maxillary anterior teeth, tooth rotation, over-eruption, migration, tooth loss, irregular interdental spacing and a traumatic occlusion. Dental and occlusal changes generally result from diminished support as a result of the diseased periodontium.[1-7]

It is critically important to identify patients who are susceptible to the more severe manifestations of periodontal disease and to control existing pathology prior to commencing orthodontic treatment.[4]

Interdisciplinary teamwork is essential to diagnose, manage and plan the appropriate treatment for patients with significant periodontal attachment loss. Teamwork is also important in monitoring the periodontal health of patients throughout and following the course of orthodontic therapy.[8]

Orthodontic therapy can play an integral role in the rehabilitation of the appearance and function of periodontally-compromised patients. A satisfactory long-term prognosis is possible if the patient is motivated and responds well to initial periodontal therapy. Periodontal health is a central requirement for any form of dental treatment. Excellent home care and professional maintenance visits are essential.[4]

Case report

Periodontal and endodontic diagnosis

A 62-year-old female patient was referred by her general dentist to a specialist periodontist for assessment and treatment of her periodontal condition. The chief complaints were recent gingival abscesses, the potential for further tooth loss due to her periodontal disease and concern regarding her smile aesthetics. She had never been a smoker and was currently taking medication for high cholesterol levels. Her medical history was otherwise relatively uncomplicated. A comprehensive periodontal examination was performed and a panoramic radiograph was obtained (Figure 1). Generalised advanced gingival probing depths with associated bleeding were recorded throughout the dentition, with several involved areas also exhibiting suppuration. A comprehensive periodontal charting recorded bleeding on probing in 65.4% of the examined sites. Generalised grade 1 tooth mobility was also evident. The 24 and 43 were

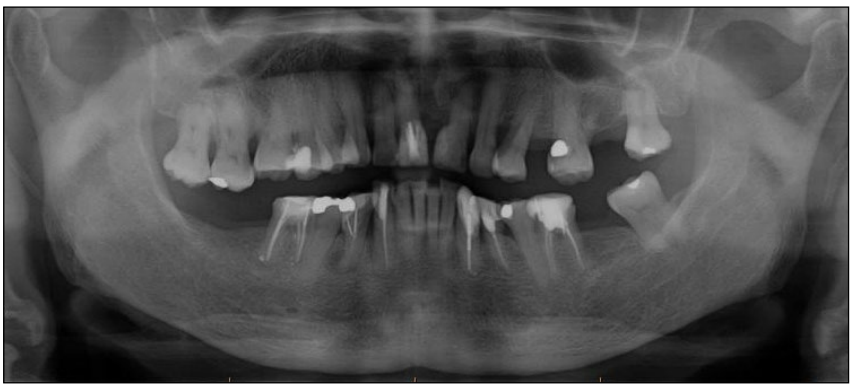

Figure 1. Pretreatment panoramic radiograph.

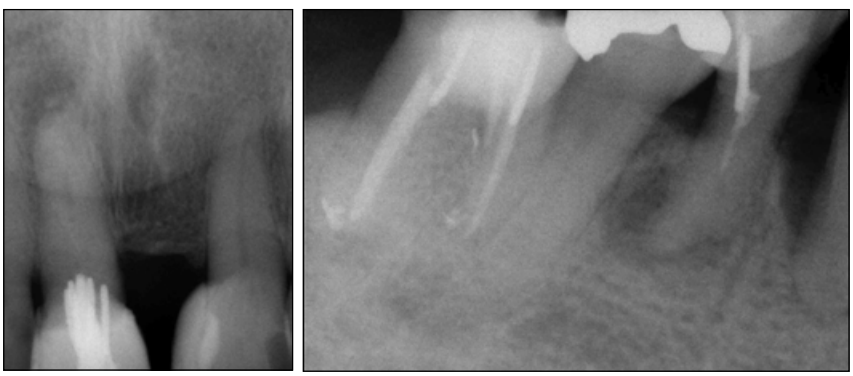

Figure 2. Periapical radiographs demonstrate periapical infections associated with the 11 and 44.

determined to have poor long-term prognosis due to large vertical bony defects. Caries was present in the mesial aspect of the 17. The 17 and 18 teeth had advanced periodontal disease and were non-functional. The diagnostic findings are summarised in Table I.

Periapical radiolucencies were associated with the apices of the 11 and 44 (Figure 2), with the premolar having a history of previous endodontic therapy. A recommendation was made to have the dentition assessed by an endodontist. The panoramic radiograph was also suggestive of a perforation in the furcation area of the 36.

Table Ia. Periodontal diagnostic summary.

• Generalised advanced chronic periodontitis
• Chronic periapical periodontitis associated with the apex of 11
• Endodontic abscess associated with the 44
• Non-functional 17 and 18

Table Ib. Endodontic diagnostic summary.

• Non-vital 11 requiring endodontic treatment
• Re-treatment of the 44 was required due to the periapical infection
• Monitor the asymptomatic 36

Endodontic management

The endodontic treatment of 11 and 44 was completed (Figure 3) and involved canal debridement and irrigation with a combination of 4% sodium hypochlorite (NaOCl), 17% ethylenediaminetetraacetic acid (EDTA), 5% chlorhexidine and ultrasonic activation. Obturation was performed by lateral compaction using gutta percha and AH Plus® (Dentsply Sirona, PA, USA) and the canal orifice sealed with a dentine bonding agent and clear resin. The access cavity was subsequently closed with Cavit™ (3M Oral Care, MN, USA) and Fuji IX GP® (GC America Inc., IL, USA). Eventually, full coverage crowns were planned for these teeth.

Periodontal management and reassessment

Following non-surgical specialist periodontal treatment, a three-month review revealed significant improvement in the periodontal parameters. Comprehensive

Figure 3. Periapical radiographs taken following successful endodontic treatment of the 11 and 44.

charting revealed that the bleeding on probing had reduced to 1.9% of sites examined. The 26 had a questionable long-term prognosis due to the distal furcation involvement; however, a decision was made not to remove the tooth at this stage. The patient attained and subsequently maintained an excellent standard of oral hygiene through meticulous home care.

Given her continued demonstration of excellent oral hygiene and compliance, the periodontist considered this patient a suitable candidate for subsequent orthodontic and prosthodontic treatment in order to address her desire to achieve pleasing anterior smile aesthetics. Interdisciplinary management was proposed, requiring communication and input between the periodontist, endodontist, orthodontist, prosthodontist and the general dental practitioner.

Orthodontic diagnosis

An orthodontic assessment recorded the presence of a Class II division I malocclusion on a mild skeletal Class II base with mesofacial vertical proportions (Figure 4). A cephalometric analysis determined that the skeletal discrepancy was mild and the upper and lower incisors were proclined (Figure 5 and Table II).

The anterior overjet was 7.5 mm with a slightly deep anterior overbite covering approximately 50% of the lower incisors. The 21, 25 and 27 had been previously extracted and the upper dental midline was displaced 4 mm to the left of the facial midline. The 22 had been restored with composite resin to increase its mesiodistal width and to resemble the missing 21. The 37, 47 and 48 were absent from the lower arch. Severe lower anterior crowding with evidence of significant pre-existing wear of the lower incisors was recorded. The 17 and 18 had over-erupted and were considered non-functional.

Table II. Cephalometric analysis – summary data (norms and standard deviation).

Mild skeletal Class II	ANB 4.2 degrees (2.0 +/- 2.4 degrees) *(Steiner)*
Mesofacial vertical facial morphology	Facial axis angle: 87.6 degrees (90.0 +/- 3.5 degrees) *(Ricketts)*
	Mandibular plane angle 22.4 degrees (23.9 +/- 4.5 degrees) *(Ricketts)*
	Proclined upper incisors: UI-FH 124.9 degrees (111.0 +/- 6.0 degrees) *(Ricketts)*
	Proclined lower incisors: LI-MD Plane 108.1 degrees (95.0 +/- 7.0 degrees) *(Roth-Jarabak)*
	Reduced interincisal angle: 106.9 degrees (130 +/- 6.0 degrees) *(Ricketts)*
	Adult patient (i.e., no significant remaining growth potential)

The panoramic radiograph demonstrated a heavily restored dentition with significant generalised periodontal attachment loss and a periapical lesion associated with the 44. A prioritised problem list and corresponding treatment objectives are outlined in Table III.

Interdisciplinary treatment plan

Following completion and stabilisation of the periodontal and endodontic status, a plan involving the extraction of 41, followed by upper and lower fixed appliances to align the teeth and facilitate future prosthodontic replacement of the missing 21, was presented to the patient.

Figure 4. Pretreatment orthodontic diagnostic photographic records.

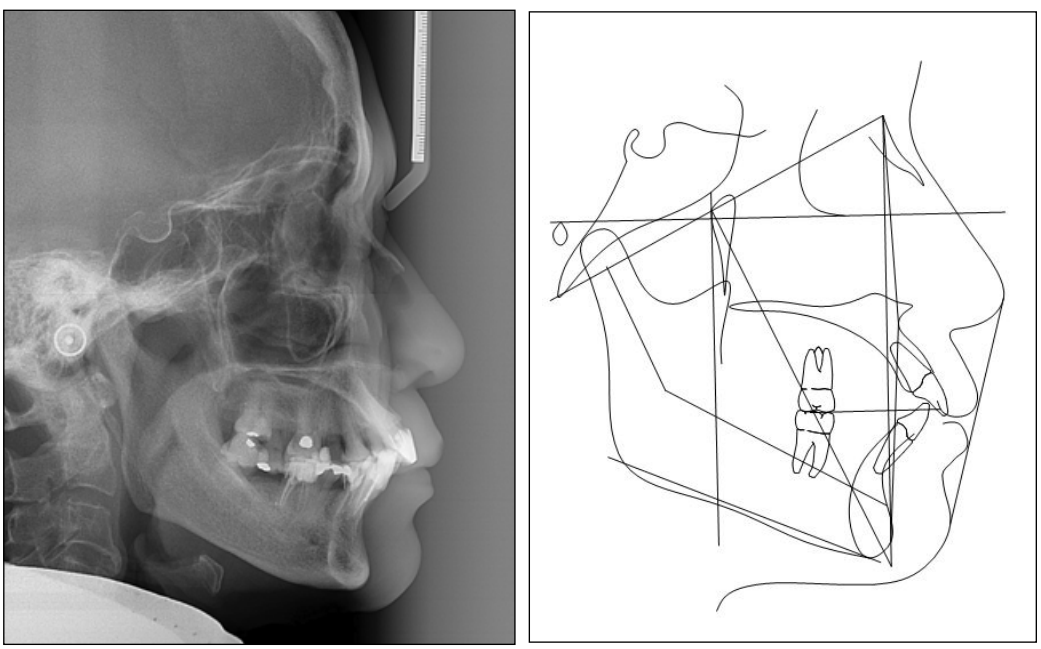

Figure 5. Pretreatment cephalogram and cephalometric tracing.

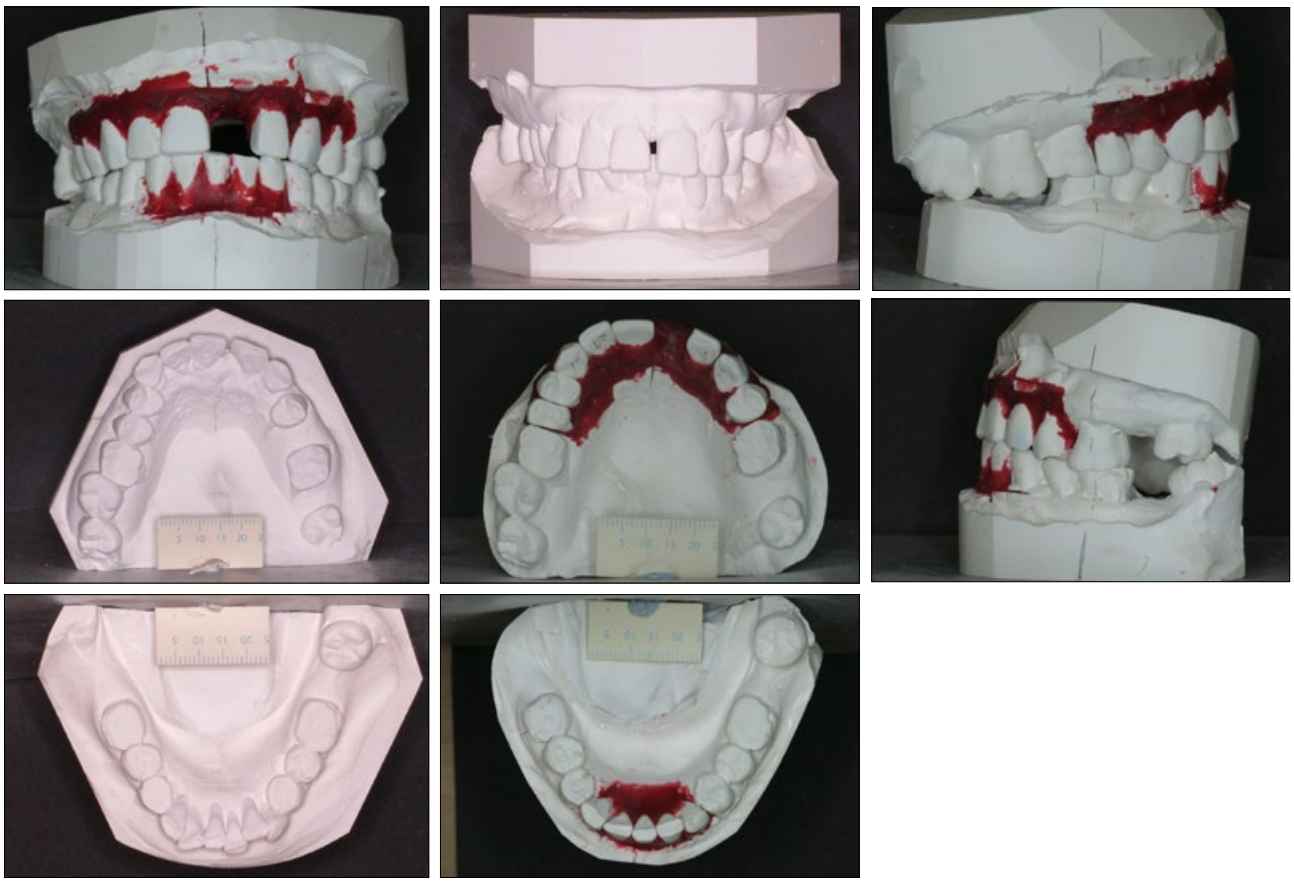

Figure 6. A diagnostic study model was sectioned and set-up to predict the outcome of the proposed orthodontic tooth movements. The 41 was extracted to facilitate correction of the lower anterior crowding and space was redistributed in the upper arch to open space for the future 21 implant.

Table IIIa. Prioritised problem list.

1.	Significant generalised periodontal attachment loss with missing 21, 25, 27, 37, 47, 48 and over-erupted 17 and 18
2.	Heavily restored dentition with previous endodontic treatment of 11, 36, 34, 33, 43, 44 and 46
3.	Significant upper dental midline discrepancy (4 mm to LHS of the facial midline)
4.	Severe lower anterior crowding and with limited scope for dimensional change of the arch form due to the significant pre-existing periodontal compromise associated with the lower dentition

Table IIIb. Treatment objectives.

1.	Achieve and maintain stability of the periodontal condition prior to, during and following orthodontic treatment
2.	Appropriately treat and monitor the endodontic status of the heavily restored dentition
3.	Correct the upper midline discrepancy and facilitate future implant replacement for the missing 21 using upper and lower fixed orthodontic appliances to effectively redistribute the space in the upper arch
4.	Orthodontically level and align the arches and redistribute residual extraction spaces to provide a functional occlusion within the anatomic and soft tissue limitations of the patient

A diagnostic study model set-up was performed to assess the viability of this treatment option (Figure 6). Several alternative treatment options were also considered, discussed with the patient and subsequently declined (Table IV). The periodontal maintenance visits were to be conducted at three-monthly intervals throughout orthodontic treatment. The non-functional and unopposed 17 and 18 were initially left in situ as they could potentially provide anchorage for the correction of the upper midline position. These teeth were planned for removal at the completion of orthodontic treatment.

Following orthodontic treatment, it was planned to place a restorative implant in the 21 site. A bone graft was deemed necessary at the time of implant placement. An immediate removable acrylic partial denture would be constructed for issue on the day of stage 2 implant surgery. The final crown was to be provided by the general dental practitioner. Orthodontic retention was to be achieved by prolonged use of both fixed and removable retainers.

Treatment progress

Banding

The 41 was extracted two weeks prior to the commencement of the fixed appliance treatment. Pre-adjusted (0.022" × 0.028"slot, MBT prescription), pre-coated adhesive edgewise ceramic aesthetic upper Clarity™ Advanced brackets and lower Victory Series™ brackets were placed (3M Oral Care, MN, USA). Upper 0.016" and lower 0.013" nickel-titanium alignment archwires (Ormco, CA, USA) were placed. The composite restoration on the mesial aspect of the 22 was removed and an active nickel-titanium coil spring placed between the 11 and 22 to initiate space opening for the eventual 21 prosthesis and the required upper midline correction.

Three months

Elastomeric chain was placed from the 16 to the 11 and 26 to the 22 to continue space opening in the 21 region. An upper 0.020" × 0.020" copper nickel-titanium archwire was placed to which a 6 mm pontic tooth was ligated to improve smile aesthetics in the edentulous 21 space. A lower 0.016" nickel-titanium archwire was placed (Figure 7a).

Five months

Elastomeric chain was placed from the 16 to the 11 and 26 to the 22 to continue space opening in the 21 region. Lower arch alignment had progressed satisfactorily, which permitted the placement of a lower 0.016" × 0.022" nickel-titanium archwire (Figure 7b).

Eight months

To facilitate the upper midline correction, a larger active coil spring was placed between the 11 and the 22. In addition, 0.5 mm of interproximal reduction was performed at the contact points of the 16, 15, 14, 13, 12 and 11 to create space in the first quadrant to further improve the midline position. Elastomeric chain remained in place from the 16 to the 11 and 26 to the 22 to continue space opening. Elastomeric chain was also placed from the 33 to the 43 on the 0.016" × 0.022" nickel-titanium archwire to actively close space in the lower anterior region (Figure 7c).

Ten months

A progress panoramic (Figure 8) and cephalometric radiograph (Figure 9a) were taken along with study models to assess and facilitate additional

Table IV. Alternative treatment options.

No treatment	• This treatment option was not recommended due to the pre-existing periodontal and endodontic compromises. • The patient expressed a strong desire to proceed with the appropriate treatment required to achieve pleasing anterior smile aesthetics and maintain occlusal function.
Prosthodontic treatment	• Prosthodontic treatment in isolation would be clinically inappropriate due to the pre-existing periodontal and endodontic compromises. • Without orthodontic treatment, the upper midline discrepancy and dental asymmetry would remain unresolved.
Extraction of the 44 (rather than the 41) and interdisciplinary treatment	• The 44 was determined to be more compromised than the 41. • Removal of the 44 would result in a less than ideal canine relationship on the RHS and require more significant movement of all teeth in the lower arch. Given the heavily restored and periodontally compromised dentition, it was decided that the extent of the orthodontic tooth movement and orthodontic treatment duration be kept to an absolute minimum. • Extraction of the 41 would facilitate rapid alignment of the lower anterior segment without excessive relocation of the posterior teeth, nor major disruption of the posterior occlusion.

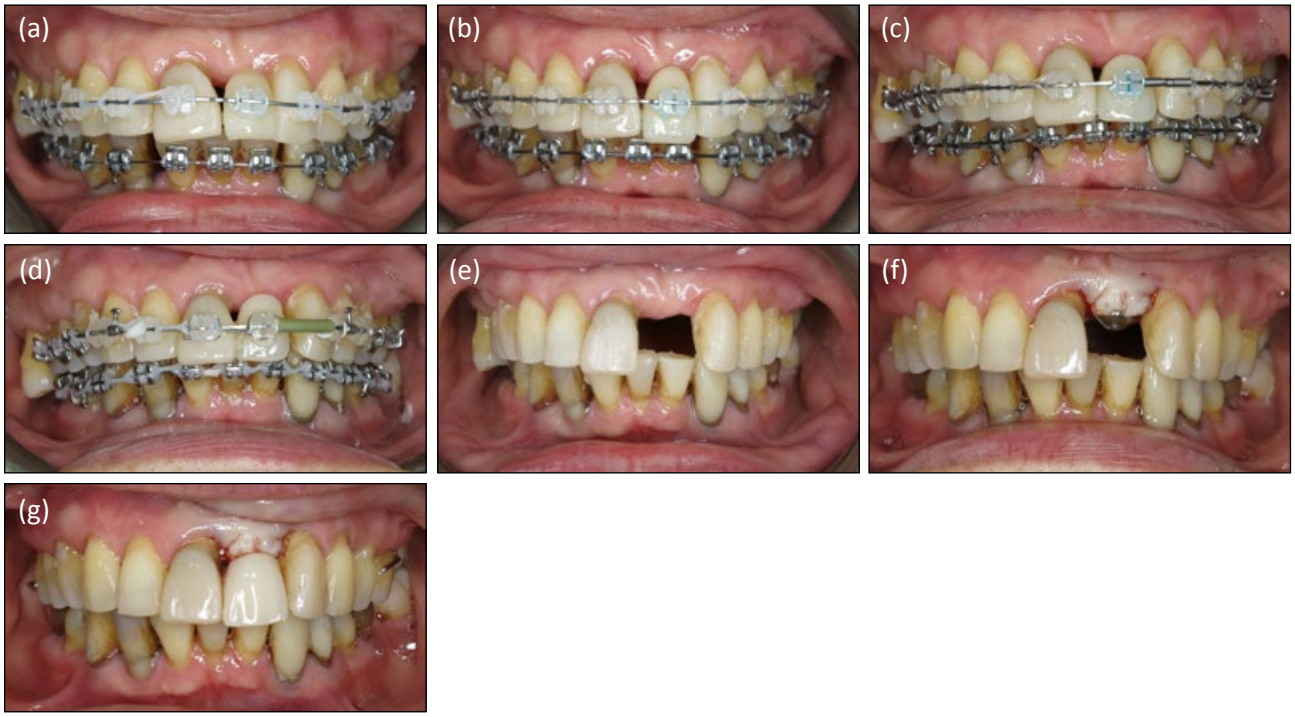

Figure 7. Frontal photographs of treatment progress at various time-points: (a) three months, (b) five months, (c) eight months, (d) 14 months, (e) 19 months, (f) 23 months – following stage 2 implant surgery, (g) 23 months – with immediate removable acrylic partial denture in place.

interdisciplinary treatment planning. Following the radiographs, an upper 0.019" × 0.025" and a lower 0.017" × 0.025" titanium-molybdenum alloy (TMA) archwire was placed. The progress cephalogram, tracing (Figure 9b) and superimposition (Figure 9c) demonstrated further proclination of the upper incisors to the Frankfort Horizontal reference plane (pretreatment: 124.9°; progress: 125.5°). The lower incisor angulation was deemed to be satisfactory as it was relatively unchanged relative to the mandibular plane (pretreatment: 105.8°; progress: 105.1°) (Figure 9). The patient was instructed to wear 1/4", 3.5 oz Class II intermaxillary elastics full-time (Ormco, CA, USA).

Twelve months

The patient was instructed to continue full-time wear of the Class II elastics.

Fourteen months

The upper dental midline position was determined to be corrected with respect to the facial midline. The 21 space along with the anterior overjet and overbite relationship were considered satisfactory by the orthodontist and periodontist. A three-dimensional computed tomography (3D CT) scan was obtained by the periodontist at this time to determine the need for a bone graft in the 21 site prior to future implant placement (Figure 10). No significant loss of periodontal attachment was evident on the reconstructed panoramic radiograph along with satisfactory root parallelism. The patient was instructed to continue full-time wear of the Class II elastics.

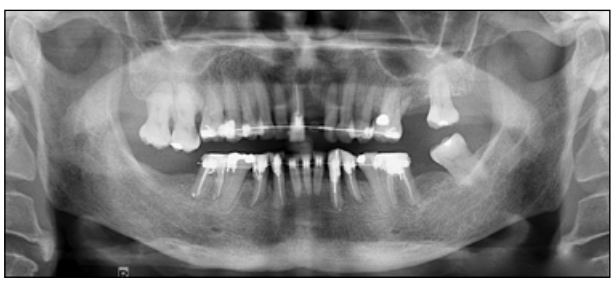

Figure 8. A progress panoramic radiograph taken 10 months into active orthodontic treatment. No significant progression in periodontal attachment loss has occurred.

Nineteen months (deband, implant surgery)

The upper and lower fixed appliances were removed following 19 months of active orthodontic treatment (Figures 11 and 13). Upper and lower 0.0175" triple-stranded stainless steel (American Orthodontics, WI, USA) fixed retainers were bonded to the upper and

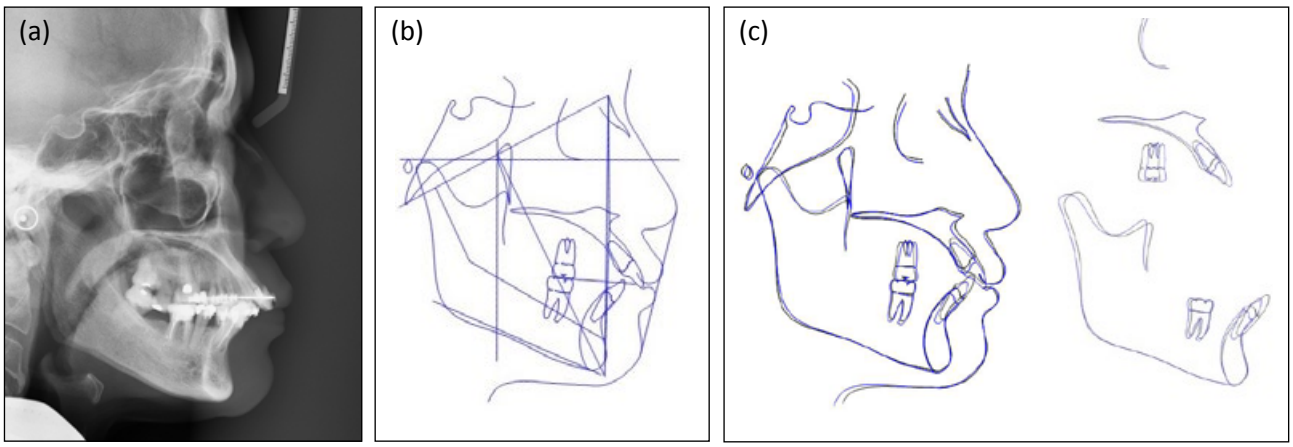

Figure 9. (a) Progress cephalometric radiograph taken 10 months into active orthodontic treatment. (b) Progress cephalometric tracing. (c) Cephalometric superimpositions.

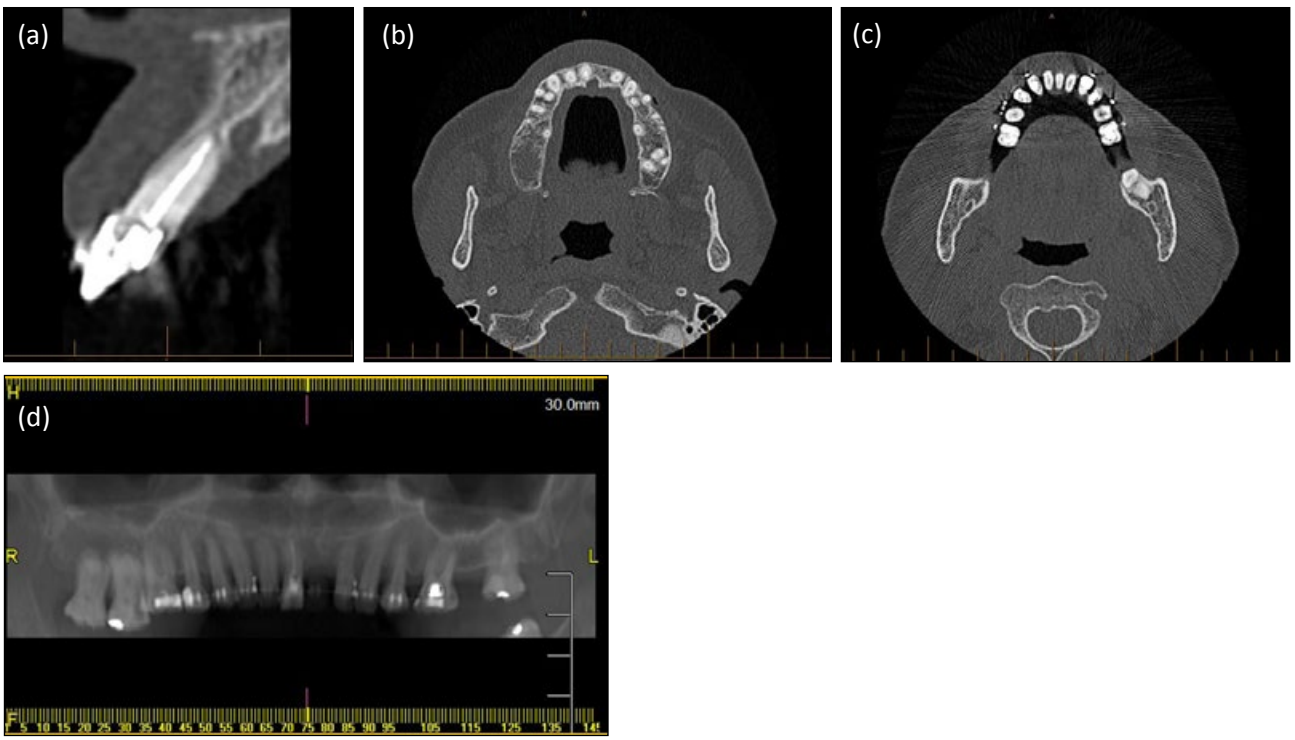

Figure 10. Pre-implant 3D CT scan. (a) Satisfactory angulation of the 11 within the alveolar ridge. (b) Upper teeth remain within the anatomical limits of the alveolar bone. (c) Lower teeth remain within the anatomical limits of the alveolar bone. (d) Reconstructed panoramic film reveals appropriate root parallelism for the planned restorative implant in the 21 edentulous space.

lower anterior teeth. Teeth with reduced periodontal attachment are generally more mobile and are prone to significant undesirable tooth movement. The triple stranded stainless steel fixed retainers provided a dual function, as orthodontic retainers and physiologic splints for the mobile anterior teeth. The upper fixed retainer was placed in two separate sections (Figure 11e) due to the 21 edentulous space.

The periodontist performed the stage 1 implant surgery on the day of fixed appliance removal. A 4.3×10 mm *Replace Select*™ implant (Nobel Biocare Zürich-Flughafen, Switzerland) was inserted in the area along with a concomitant bone graft utilising Bio Oss® and Bio Gide® (Geistlich Pharma North America Inc., NJ, USA) on the labial aspect. The implant was submerged to ensure optimal healing. The 17 and 18 teeth were also extracted at this time. The over-erupted posterior teeth were left in situ during treatment as they were considered for use as additional anchorage units to facilitate the required upper arch

Figure 11. Upper occlusal photographs of treatment progress at various time-points: (a) three months, (b) five months, (c) eight months, (d) 14 months, (e) 19 months, (f) 23 months – following stage 2 implant surgery, (g) 23 months – with immediate removable acrylic partial denture in place.

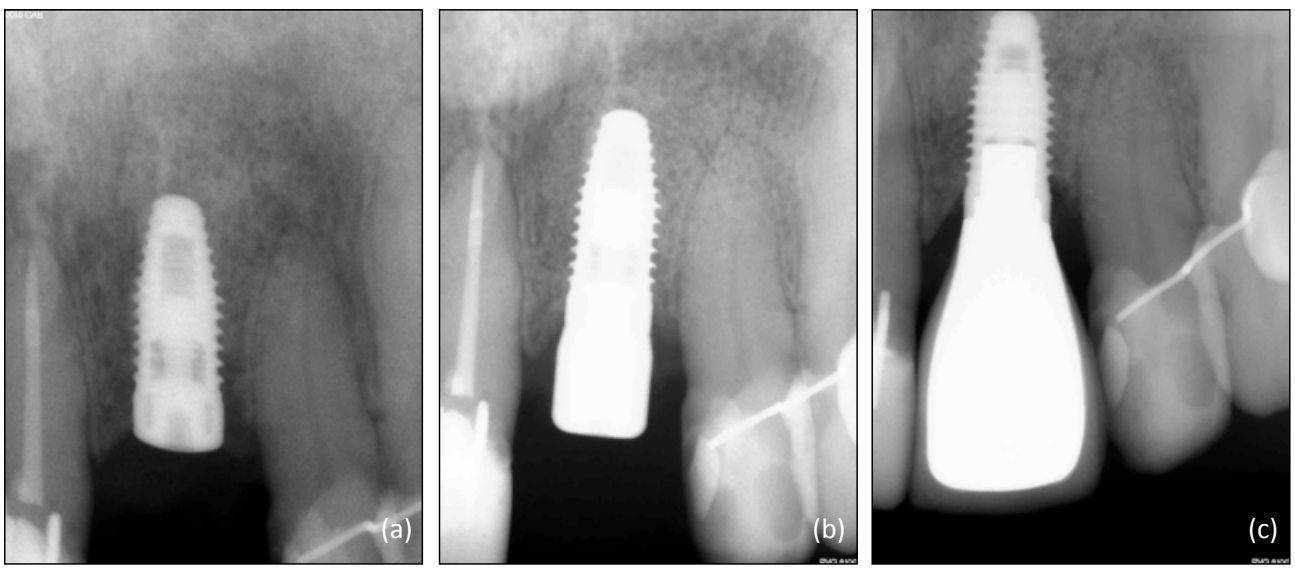

Figure 12. (a) Stage 1 implant surgery. (b) Stage 2 implant surgery. (c) Final restorative implant demonstrating successful osseointegration.

tooth movement. These teeth were not bonded during the fixed appliance phase as this additional anchorage was not required to achieve correction of the upper midline discrepancy.

The patient returned to the orthodontist on the same afternoon and upper and lower removable vacuum-formed (Dentsply Raintree Essix™, FL, USA) retainers were issued. The acrylic denture pontic tooth used during the orthodontic treatment was placed in the upper removable retainer to provide a temporary cosmetic solution for the missing 21. Most importantly, the upper removable retainer and pontic tooth avoided contact with the bone graft and implant in the 21 region. Instructions were given to wear the upper removable retainer throughout the day and to remove it nocturnally. The lower removable retainer was to be worn at night indefinitely.

Four months later, stage 2 implant surgery was performed after the implant had demonstrated evidence of successful osseointegration (Figure 12). Resonance frequency testing using an Osstrell™ (Gothenburg, Sweden) instrument yielded a satisfactory value of 72. A 5 mm healing abutment was placed on the implant and some keratinised tissue was labially repositioned to augment the soft tissue in this area. An immediate upper partial acrylic denture was made by the general dentist and adjusted to fit over the implant. The general dental practitioner also provided the final ceramic restoration. Despite the 21 crown being slightly larger in the mesiodistal dimension compared with the 11, the overall facial and anterior smile aesthetics were pleasing (Figure 13). An upper removable retainer was subsequently made and the patient was instructed wear both upper and lower Essix™ retainers at night. Due to the large geographical distance between the patient's residence and the treating orthodontist's practice, the orthodontist recommended the indefinite use of both fixed and removable retainers. This comprehensive retention protocol would also significantly reduce the potential relapse should the fixed retainer adhesive detach or the removable retainer become damaged or misplaced.

Figure 13. Post-treatment photographs taken at 28 months (nine months post-deband). The 21 implant has been restored with a ceramic crown.

Discussion

This case report demonstrates a pleasing treatment outcome for a patient with a periodontally-compromised dentition. Careful diagnosis and interdisciplinary management formed the cornerstones of the overall treatment regime.

Endodontically-treated teeth can be successfully moved orthodontically as readily as vital teeth. However, endodontically-treated teeth must have a tight coronal seal to prevent bacterial leakage and the possibility of recurrent infection.[9]

It has been shown that, for patients with an absence of periodontal disease and good oral hygiene, appropriate orthodontic treatment will not result in any significant long-term effects on periodontal attachment and bone levels.[10-14] This also applies to adults with healthy yet reduced periodontal support. Indeed, orthodontic treatment can often be expedited due to the reduction in supporting periodontium. In adults with active periodontitis, orthodontic tooth movement may result in an acceleration of the disease process.[14-16] Vigilance must be demonstrated in furcation areas due to the likely accumulation of plaque despite the patient's best attempts at meticulous oral hygiene. In such cases, deterioration of the periodontium may occur during a course of orthodontic treatment.

Periodontal pathogenesis is strongly related to the bacterial flora and how an individual manages its presence, with hygiene and the immune response both of critical importance. Individual patients have varying susceptibility to the loss of periodontal attachment. However, patients who have previously experienced significant loss have an inherently greater risk of further loss. During orthodontic treatment planning, clinicians must carefully evaluate the soft tissue periodontium and supporting alveolar bone. Periodontally-compromised patients cannot afford to have teeth moved outside bony anatomical limits, as further loss of attachment is likely to occur as a result, especially if there is associated or subsequent inflammation.[17] Fortunately, the presented patient attained periodontal stability prior to, and maintained an excellent standard of oral hygiene, throughout orthodontic treatment. No significant loss of attachment was detected by the periodontist at any of the periodic reviews.

The extraction of a single lower incisor remains a controversial treatment option.[18] It is performed infrequently, with the relevant literature reporting relatively low incisor extraction frequencies ranging from less than 1.1%[19] to 6%[20] of all patients undergoing orthodontic treatment. However, there are several clinical scenarios in which the extraction of a lower incisor might be indicated. These include a relative mandibular tooth-size excess, a significant mandibular tooth-size to arch-length discrepancy, structurally or periodontally-compromised teeth, the presence of a supernumerary lower incisor, the ectopic eruption of a lower incisor and mild to moderate Class III malocclusions with minimal overbite or an open bite tendency.[18]

There are also several contraindications against the extraction of a lower incisor, including patients with a significant anterior maxillary tooth-size excess, deep overbite, increased overjet, triangular shaped lower incisors and some cases presenting with periodontal disease.[18]

The removal of a single lower incisor generally results in relatively predictable occlusal effects. These effects include an increase in the overjet and overbite, resultant midline discordance and mesially-positioned lower canines at the completion of treatment.

Depending upon the individual case, these outcomes may be favourable or unfavourable. Careful case selection and planning is mandatory and should include a tooth-size analysis and a diagnostic study model set-up. In the majority of cases, there is minimal impact on the profile and posterior dentition.[18]

The decision to extract the 41 was made following careful consideration of the pre-existing periodontal and endodontic concerns, combined with the expected future prosthodontic requirements. The significant lower arch crowding was resolved without undue arch expansion and significant movement of the heavily restored posterior dentition was avoided.

Conclusion

A cohesive interdisciplinary relationship is vital for the diagnosis, treatment planning and clinical management of patients with periodontal and endodontic compromises. Appropriate stabilisation of the periodontal and endodontic condition is a non-negotiable prerequisite for subsequent orthodontic and prosthodontic treatment. Detailed discussion of the inherent risks and benefits of the reasonable and relevant treatment options is essential for adequate

informed consent. Following this, carefully considered treatment objectives and well-executed treatment can ultimately provide a pleasing outcome.

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Corresponding author

Dr Desmond Ong
Clinical Academic
Orthodontic Department
School of Dentistry
The University of Queensland
Brisbane QLD 4072
Australia

Email: desmondc_ong@outlook.com

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